White Mountain Apache Tribe
EXECUTIVE OFFICE OF THE CHAIRMAN
Dallas Massey Sr., Tribal Chairman

September 30, 1998

Unified Watershed Assessment Working Group
U.S. Environmental Protection Agency
Mail Code 4503F
401 M Street, S.W.
Washington, D.C. 20460

Re: White Mountain Apache Tribe's Unified Watershed Assessment

Dear Working Group:

Enclosed is the FY'98 Unified Watershed Assessment and Watershed Restoration Priority List for the White Mountain Apache Tribe located in Whiteriver, AZ.

The Tribe's Watershed Program is submitting this information based upon the Tribe's Watershed Assessment Report and the Watershed Restoration Strategic Plan.

We are submitting this Unified Watershed Assessment in accordance with key elements described in the Clean Water Action Plan which emphasizes cooperative approaches to watershed protection and focuses resources on improving the natural environment and reducing public health threats.

We look forward to working with you in the future.

Sincerely,

Dallas Massey, Sr., Chairman
White Mountain Apache Tribe

cc: Loretta Vanegas, EPA Water Division, Region IX

P.O. Box 1150, Whiteriver, Arizona 85941
telephone (520) 338-1560 • facsimile (520) 338-1514


GREAT SEAL
WHITE MOUNTAIN APACHE TRIBE

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The White Mountain Apache Tribe's Unified Watershed Assessment and Watershed Restoration Priorities

September 30, 1998

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White Mountain Apache Tribe
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Table of Contents

Unified Watershed Assessment and Restoration Priorities

The White Mountain Apache Tribe has conducted several initiatives to assess the health of its watersheds and set forth a strategy for restoring them. The Tribe's Unified Watershed Assessment and Restoration Priorities are based upon two documents:

Watershed Assessment Report

- This summary of Reservation watershed conditions was first prepared in 1996 and has been revised annually since then. This report evaluates the functional condition of riparian areas and identifies water quality concerns and impairments. Supplemental reports provide greater detail for particular restoration sites.

Watershed Restoration Strategic Plan

- Adopted by the Tribe in 1998, this plan identifies techniques and priorities for restoring ecosystem health.

Together, these documents meet the challenges set forth in the President's Clean Water Action Plan. Below are summaries of these documents following the format of the Clean Water Action Plan.

Unified Watershed Assessment

A Tribal Watershed Assessment was first compiled in 1996 and is now being updated for the second time. It was written to meet the requirements of a Section 305(b) Water Quality Report as well as to provide an assessment of watershed health using other physical and biological parameters. This version has revisions based on results of monitoring data and restoration projects in 1998. The document incorporates the categorization system outlined in the Clean Water Action Plan to identify whether watersheds are meeting or not meeting clean water and other natural resources goals.

Measures and Indicators

The following measures and indicators were used to determine the status of the watersheds:

- health of native aquatic species
- water quality concerns, based upon comparisons to tribal standards
- functionality of riparian ecosystems, as indicated by channel morphology, riparian vegetation, bank erosion, and substrate condition

The Watershed Program evaluates riparian and aquatic systems as functional, at-risk, or dysfunctional. A properly functioning system has viable populations of key native riparian and aquatic species and a morphology and biotic components that will sustain high levels of productivity under natural disturbance regimes. A dysfunctional system operates at a low level of productivity and will not regain proper functioning condition without active intervention. An at-risk system could become dysfunctional when struck by natural disturbances such as a fires, droughts or floods.

Based on the evaluations conducted by the Watershed Program and supplemented by reports from other sources, all the four major watersheds on the Reservation suffer from degraded conditions in the main stem and major tributaries.

Methods of Assessment

Numerous stream monitoring stations have been established throughout the four major watersheds. Furthermore, many qualitative assessments by Watershed Program staff have been conducted at other locations throughout these watersheds.

Information on the status of aquatic species comes from surveys conducted by the Tribal Fisheries Program and USFWS Pinetop Fishery Resources Office. Intensive assessment work on the health of Apache Trout in the Black and White watersheds has been conducted as part of the Apache Trout Recovery program. Studies on the status of native fishes have been conducted on the Salt River and White River.

Water quality conditions have been sampled extensively across the Reservation and intensively at selected sites. The frequency and results of this sampling are summarized in the watershed assessment report.

White River: Category I Needing Restoration

Decline in condition of living resources in the aquatic system

- Loach Minnow (a threatened species) in North Fork, East Fork, and main stem
- Other native fish species in the watershed are in decline due to encroachment by exotic species
- Apache Trout are a species of concern in the upper parts of the North Fork and East Fork watersheds

Water Quality concerns

- Temperature impacts (not meeting cold water criteria)
- Turbidity concerns
- Fecal Coliform concerns

Degraded aquatic system and Non-attainment of Natural Resource Goals

- Dysfunctional riparian habitats in East Fork below Firebox Creek and North Fork below Alchesay Flat
- Dysfunctional habitats and unacceptable levels of erosion in Trout Creek and Firebox Creek watersheds
- Severe bank erosion jeopardizing fish habitat and traditional use for farmland

Black River: Category I Needing Restoration

Decline in condition of living resources in the aquatic system

- Apache Trout are a concern in Soldier Spring Creek, Big Bonito drainage, Paddy Creek, and Hurricane Creek
- Loach Minnow (threatened species) has been found in the upper portion of Black River off the Reservation; it is not known whether suitable habitat exists on the Reservation in this watershed
- Other native fish species in the watershed are in decline due to encroachment by exotic species

Water Quality concerns

- Temperature
- Turbidity

Degraded aquatic system and Non-attainment of Natural Resource Goals

- Dysfunctional riparian habitats along Pacheta Creek, Reservation Creek, Soldier Spring Creek, Lofer Creek, Boggy Creek, and Corn Creek

- Degraded wetland habitats in cienegas

Carrizo Creek: Category I Needing Restoration

Decline in condition of living resources in the aquatic system

- Native fish species, including Roundtail Chub may be in decline and are threatened by exotic species.

Water Quality concerns

- Temperature
- Turbidity

Degraded aquatic system and Non-attainment of Natural Resource Goals

- Dysfunctional riparian habitats in main stem of the Carrizo and major tributaries as indicated by wide and shallow morphology, and degraded riparian vegetation
- Severe bank erosion jeopardizing fish habitat and traditional use for farmland.
- Dysfunctional riparian habitat on Cedar Creek and its three forks, as indicated by invasion of salt cedar, lack of perennial flows, wide and shallow morphology, and degraded habitat for aquatic life

Upper Salt River: Category I Needing Restoration

Decline in condition of living resources in the aquatic system

- Native fish species in the watershed are in severe decline due to encroachment by exotic species.

Water Quality concerns

- Temperature concerns in Cibecue Creek
- Turbidity concerns
- Fecal Coliform concerns

Degraded aquatic system and Non-attainment of Natural Resource Goals

- Dysfunctional riparian habitats in Cibecue Creek and Canyon Creek
- Degraded aquatic habitats in main stem of Salt River
- Severe bank erosion jeopardizing fish habitat and traditional use for farmland.

Watershed Restoration Priorities

The Watershed Restoration Strategic Plan was completed and adopted by the Tribal Council in 1998. It meets the requirements of a Nonpoint Source Management Program, as specified in Section 319 of the Clean Water Act.

All the watersheds on the Reservation are in need of restoration efforts. Projects are currently underway at selected sites in all four watersheds, and new ones have been planned. The top priority for an expanded restoration program is to establish demonstration projects to restore reaches along the major streams in community areas, including Cibecue Creek, Carrizo Creek, and the East Fork, North Fork, and main stem of the White River at Canyon Day. The ID restoration area in the Black Watershed has been targeted for restoration with support from an EPA Wetlands Grant.

Process for evaluating Restoration Priorities

Numerous public meetings were held in tribal communities across the Reservation in preparation for establishing the tribal Land Restoration Fund. 20% of the Tribe's settlement against the Federal Government for land mismanagement was set aside to establish this permanent fund. During this meetings, much discussion took place concerning priorities areas for restoration.
The tribal Watershed Program prepared a Watershed Restoration Strategic Plan in late 1997. Copies of the draft plan were circulated among tribal departments for review. Two public meetings were held in Cibecue and Whiteriver in March to present the plan and discuss priority areas. The Tribal Council officially adopted the Plan in April 1998, and the EPA approved the Tribe's Nonpoint Source management program in August 1998.

The Tribe has held annual meetings to review its Statement of Relationship with the US Fish and Wildlife Service. The major platform of this agreement is that the Service will assist the Tribe in promoting the health of its ecosystems on a watershed basis, emphasizing riparian restoration. At the annual meetings, the Tribe and Service have identified priority projects for restoration.

Process for Implementation of Restoration Priority Projects

Land Restoration Board Selection of Projects

The Tribal Land Restoration Board will direct the Tribe's restoration efforts. Board members will work with community members to identify local priorities. The Tribal Watershed Program will staff the Board to help design, implement, and evaluate restoration projects. The focus of the program will be to implement demonstration projects and evaluate their success for application to other areas.

Projects will be submitted for funding to various grant sources, including the EPA and NRCS, with matching support from the Tribe's Permanent Land Restoration Fund.

Implementation of Demonstration Projects

The priority for watershed restoration will be projects that demonstrate the use of particular restoration tools to address problems in watershed health. Successful tools will be incorporated into general resource management. Priority issues to be addressed through this process include:

- design and maintenance of irrigation diversions
- road impacts to streams
- management of exotic fish species
- management of exotic plant species
- channel restoration design

Community Education

An important facet of watershed restoration is interacting with local community members to address their concerns and involve them in restoration activities. To accomplish this objective, community members must learn more about the causes of degradation and ways to address them. Therefore, community education will be a necessary element of restoration projects.

Schedule for Implementation

A specific schedule for restoration projects is outlined in the Watershed Restoration Strategic Plan. Actual project initiation and completion is contingent upon receiving adequate funding and may change based on the priorities identified by the Land Restoration Board, Tribal Council, and local communities. Below is a summary of the status of restoration efforts in the major watersheds.

White Watershed

- The Tribe submitted a grant application to the US EPA Nonpoint Source Management (Section 319) Program to restore major rivers in the White River watershed.
- The Tribe completed a project to close a road that was a major source of sediment into Firebox Creek in the East Fork Watershed, with funding from the US Fish and Wildlife Service.
- The Gooseberry Watershed has been the focus of a restoration project funded through the Arizona Water Protection Fund. The Tribe prepared an application to the AWPF to actively restore meadows in the watershed through a second phase of this project.
- The Upper North Fork Watershed has been assessed through the Tribe's Watershed Program under the Water Pollution Control Grant.

Black Watershed

- Lofer Cienega in the Big Bonito drainage has been the focus of a major restoration effort funded by the Arizona Water Protection Fund. The Tribe has prepared an application to the AWPF to expand upon this work.
- The Tribe has received an EPA Wetlands Grant to evaluate and restore conditions of wetlands in the Black Watershed Restoration Area.\
- The Tribe has completed the first phase of a project to restore Soldier Spring with funding from the US Fish and Wildlife Service.

Carrizo Watershed

- Several restoration projects are underway in East Cedar Creek, Middle Cedar Creek, R14 Crossing, and Limestone Canyon.
- A proposal has been prepared to restore part of the main stem of Carrizo Creek, and it was submitted to the US Fish and Wildlife Service for their consideration.

Upper Salt Watershed

- The Cibecue Watershed has been analyzed through a special EPA Watershed Analysis and Management Grant. This process has led to the creation of a draft Analysis and Restoration Plan. The Tribe applied for a grant from the Arizona Water Protection Fund to restore 2 miles of river upstream of the community. Several smaller restoration projects have begun at White Springs and in town.
- The Salt River / Medicine Ecosystem Area has been the target of an integrated planning effort centered around promotion of watershed health in concert with increased recreational opportunities. This project led to the removal of several hundred maverick cattle from the Salt River corridor and a demonstration prescribed burn for the area.

Watershed Assessment Report

I. Purpose and Background

This report describes the conditions of watershed health on the White Mountain Apache Reservation. The purpose of this report is to provide information regarding the state of the waters of the Reservation, including the following elements:

- state of water quality, consistent with the guidelines in Section 305(b) of the Clean Water Act
- an assessment of nonpoint source impacts consistent with the guidelines in Section 319 of the Clean Water Act
- an assessment of watershed conditions consistent with the Unified Watershed Assessment Framework
- riparian and channel conditions at selected sites, including restoration projects funded under a Challenge Cost-Share Grant awarded by the US Fish and Wildlife Service and with funds from the State of Arizona's Water Protection Fund

The report provides this information within the broad context of riparian and watershed health, since most of the water quality problems on the Reservation are the result of watershed degradation rather than discharges. The period of record for this report is July 1994 through June 1998. This report also provides a summary of measured and suspected water quality impairments based on the Tribe's water quality standards.

This report is intended to be a comprehensive survey of watershed conditions, although additional reports provide greater detail for particular areas. Many of the conclusions are preliminary and will require continued investigations to determine the extent of suspected problems. This report may raise more questions than it answers; yet that is a necessary step in advancing the Tribe's efforts to protect and restore its waters. A main objective of this report is to identify priorities for monitoring and restoration; a second is to identify the best ways to conduct those activities.

Future revisions of this report will address other areas of the Reservation as well as provide updates on ongoing restoration projects and long-term monitoring.

Overview of Water Resources

The Fort Apache Indian Reservation includes the following water resources:

623 miles of perennial streams

5040 miles of intermittent streams

2686 acres of reservoirs or lakes (mostly in 26 constructed reservoirs--the few natural lakes are relatively shallow and small)

341 springs

These figures are based on USGS maps associated with aerial photography, and therefore contain inaccuracies, specifically in distinguishing between perennial and intermittent streams and in identifying springs.

Wetland resources are being recorded into the Tribe's GIS based on National Wetlands Inventory maps, which appear to be relatively accurate for palustrine and lacustrine wetlands. The riverine wetland areas are probably less accurate due to the shifting of channels. Total wetland acreage must be estimated due to the lack of comprehensive maps and data; the best estimate and the methods for obtaining that estimate will be described in the Wetlands Conservation Plan.

Ecoregions and Biotic Communities

The Fort Apache Indian Reservation falls into the Arizona and New Mexico Mountains ecoregion. However, this designation does not distinguish variability within the Reservation. The biotic community classification system developed by Browne and Lowe (Biotic Communities of the Southwest, University of Utah Press, 1980), which identifies the following communities:

1. Desertscrub--Arizona Upland Subdivision
2. Interior Chaparral
3. Semidesert Grassland
4. Plains and Great Basin Grassland
5. Great Basin Conifer Woodland
6. Petran Montane (Rocky Mountain) Conifer Forest
7. Petran Subalpine (Rocky Mountain) Conifer Forest

This classification provides only a coarse overview of the diverse vegetation of the Reservation.

The tribal wetland planner has prepared a wetland classification system for inclusion in the Tribal Wetlands Conservation Plan. Major wetland areas include the cienegas (wet meadows) in the mountains south and northwest of the White Mountains, riparian areas along the perennial rivers, and isolated springs, seeps, and sinkholes ("lakes") across the west end.

Climate

Precipitation increases with elevation; the areas around Mt. Baldy may get over 36 inches annually, while the regions near the Salt River drop below 15 inches. Most of the community areas receive around 20 inches annually. Precipitation is roughly evenly divided between winter snows (and sometimes rains) and summer monsoons, which are the intense afternoon rains from July to September. By May the snows are usually melted; May and June are the driest months; and snows usually come to the high country in November. Winter snowfall appear to be controlled by the el Niño cycle, with those years producing higher snowfall, and la Niña years producing less snowfall. Temperatures are generally mild for the Southwest, with an average temperature in Whiteriver in July of about 90 degrees Fahrenheit. However, temperatures can fluctuate wildly both in time and across space. The lowest point on the Reservation may reach temperatures of 110 degrees in summer, while Mt. Baldy and other mountainous areas may drop to 40 degrees below zero in winter.

Population

The total population on the Reservation is estimated at 13,000, the vast majority of which (about 9,000) lives in the greater Whiteriver area (including Canyon Day, East Fork, and North Fork). About 2,000 people live in the community of Cibecue, the remainder live in the communities of Hondah, McNary, Cedar Creek and Carrizo.

Economy and Land Use

The major source of income to the Tribe now is the casino, which occupies a few acres at Hondah in the Corduroy Watershed. The second largest employer and income generator is the tribal sawmill, FATCO. Approximately half of the Reservation is currently managed as commercial forest, including virtually all of the 700,000 acres of Ponderosa Pine and mixed-conifer forest. About 30,000 acres of spruce-alpine fir forest occurs in commercial forest and forest reserves. Another 650,000 acres are dominated by juniper-piñon woodland, which is currently used for woodcutting and hunting. Livestock grazing is present throughout the Reservation except for a large reserve surrounding Mount Baldy. Farming continues along major perennial rivers in communities such as East Fork, Whiteriver, Canyon Day, Cedar Creek, Carrizo, and Cibecue; although the irrigation systems and enthusiasm for farming continue to gradually decline from their heyday. The only mining activity is sand, gravel, and cinder extraction in a few areas bordering rivers and at upland sites across the Reservation. Major industry is located at the FATCO area near Whiteriver, and at the sawmill in Cibecue. Tourism and recreation are industries that are growing and are expected to support a greater percentage of the tribal economy into the future. Currently, big-game hunting and white-water rafting are popular activities that generate significant revenues to the Tribe. The Tribe is currently developing programs to promote eco-tourism that will provide sustainable returns without sacrificing environmental quality.

II. Monitoring and Assessment Approaches

Data Sources

Data sources for this report included monitoring data collected by the Watershed Program following the Stream Monitoring Plan and Associated Quality Assurance Plan approved by EPA. Additional data comes from NPDES permit compliance data, including monitoring conducted by the US Fish and Wildlife Service.

The Tribe's Watershed Program has targeted limited monitoring resources at the following types of sites:

- Reservation-wide sampling points collected in 1995 to provide a broad overview of water quality on the Reservation, including several wetlands sites being assessed under a Wetlands Grant
- Streams targeted for restoration projects
- Additional water quality sampling in community areas (1998)

A US Fish and Wildlife Service Challenge Cost-Share Grant has supported monitoring at most of these sites. We will continue monitoring with available resources.

Beginning in 1997, the Watershed Program began targeting key watersheds to provide a more in-depth examination of water quality and riparian health, particularly regarding nutrient loading. The initial priorities under this approach were the Cibecue and East Fork Watersheds, because these areas appear to have the most severe and under-addressed water quality and riparian problems. Both of these watersheds are marred by upland erosion, streambank erosion, loss of shade, fisheries concerns, and abnormal levels of algal growth. Furthermore, community members have indicated that these problems are serious concerns. The rationale behind these priorities is explained further in the Watershed Program Strategy.

Monitoring Techniques

The methods used for assessing watershed health address the physical, biological, and chemical components of water quality. The specific techniques included vegetation transects, geomorphology measurements, use of a water quality probe, and other procedures outlined in the Tribe's Water Resources Monitoring Plan.

The procedures developed in the Monitoring Plan have been incorporated into a Stream Assessment Handbook, for use by tribal staff (including summer technicians and interns), and high school students. The handbook is a guide used to train stream assessment crews in the assessment techniques used by our Program. We will continue to revise and expand the Handbook through collaboration with local schools. In establishing the Cibecue Watershed Analysis and Management Project, the Tribal Planning Department has forged a partnership with the Cibecue Community School to conduct an analysis of Cibecue watershed under the

guidance of the Watershed Program. Plans are in place to develop a similar relationship with schools in other watersheds.

Sampling Frequencies

Refer to the attached table for the nature and approximate frequency of sampling at each site. Most sampling was conducted during the main growing season (spring through fall). This time frame was most critical for monitoring grazing impacts and assessing the impacts to water quality, as the monsoon rains typically result in higher sediment yield relative to water flow than during the more gradual spring snowmelt. The data collected at each site does not constitute a comprehensive assessment, but in most cases we have obtained enough information to assess conditions for management purposes (identification of stressors, design of restoration projects, and evaluation of restoration techniques). We are continuing to examine new monitoring techniques and revise our methods as appropriate.

Criteria for Assessments

Water Quality

Water quality conditions were compared to the tribal water quality standards adopted by the Tribal Council in 1998.

Stream Functionality

The functional status of streams was determined following the methods outlined by the Rocky Mountain Experiment Station (see Medina *et al.* below). This approach is based upon the methodology developed by the BLM and recently adopted by other Federal agencies (see Bridges *et al.* below). Interpretations of functional status are based on best professional judgment and reflect the synthesis of numerous indicators of stream function. Generally, dysfunctional streams are ones that are deemed to have serious physical or biological impairments that would not rectify themselves without intensive restoration or very long time frames. Functional streams, on the other hand, have all the natural components and processes needed to withstand natural perturbations (floods, wildlife impacts, etc.) without significant damage.

Channel classifications and interpretations used in this report are based on the system developed by David Rosgen (see cite below). Some channel types, such as D and F, are indicators of unnatural, dysfunctional conditions for many kinds of riparian systems. Therefore, the classification system and functional assessments are related analysis techniques.

References

Medina, Alvin L., Malchus B. Baker, Jr., and Daniel G. Neary. 1995. Desirable Functioning Processes: A conceptual approach for evaluating ecological condition. USDA Forest Service Rocky Mountain Forest and Range Experiment Station. In General Technical Report RM-GTR-272. pp. 302-311.

Bridges, Clay, Warren Hagenbuck, Russ Krapf, Steve Leonard, and Don Prichard. 1994. Riparian area management TR 1737-11: process for assessing proper functioning

condition for lentic riparian-wetland areas. USDI Bureau of Land Management, Denver CO. Technical reference 1737-11. 46 p.

Rosgen, David L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology.

White Mountain Apache Watershed Program Documents

Upper North Fork Watershed Plan (1996)

Site Assessment Reports 1995 and 1996: focused on riparian vegetation, substrate, and morphology for selected restoration sites

Lofer Cienega Monitoring Report 1996 and 1997

Gooseberry Watershed Monitoring Report 1996 and 1997

Wetlands Assessment Report and Conservation Plan (1998)

Water Quality Sampling Reports (1995 and 1997)

Cibecue Watershed Analysis and Management Plan (draft June 1998)

III. Carrizo Watershed

Carrizo Creek

Carrizo Creek below Highway 60 is heavily grazed and native wetland vegetation is scarce and in poor condition where it does occur. The problems in this area are due to concentrated livestock use due to lack of suitable forage elsewhere and fence limitations.

Carrizo Creek above the community is in better condition, with a fairly diverse assemblage of riparian vegetation. However, heavy pressures by horses (owned by residents and some unbranded feral animals) keeps the stream from recovering on its own. Certain tributaries, such as Deer Springs Canyon and Blue Springs, offer prime habitats for restoration due to the abundance of water. Better controls of horses could yield dramatic gains in watershed health.

Limestone Canyon

One of the most important tributaries to Carrizo Creek, Limestone Canyon is in fair condition. Severe gully erosion mars the lower portion of the canyon. The middle section, where the restoration project fenced the riparian area, appears to be recovering from past watershed impacts and horse grazing. We reseeded the area in spring 1998. Investigations in the summer showed that vegetation was growing vigorously in sections that had abundant water and fine sediments, while the rockier sections were slower to respond.

Corduroy Creek

Corduroy Creek above the community of Carrizo appeared to be in very good health in 1998, with diverse and healthy riparian vegetation. Fine sediments appear to be present in fairly high amounts, however, pointing to problems higher in the watershed. The main suspect is the highly erodible Amos Soil Type in Corduroy Watershed. The main Forestdale road (B65) crosses through one stretch of this soil and delivers large quantities of white sands to the creek.

Cedar Creek

Cedar Creek is a highly disturbed aquatic system within a highly disturbed watershed. The creek suffers from poor water quality and stream health. Native fish, including Speckled Dace and Suckers inhabit the system. Extensive gullying mars the entire watershed. Cedar Creek dries up below R-14 Crossing. Cedar Creek has been locked into an unhealthy condition by floodplain development combined with extensive flood control and bank protection projects, the most recent of which took place in 1993. Historic impacts from overgrazing, timber harvest and road construction in the upper portion of the watershed have undoubtedly altered the hydrology and morphology of the stream, inducing erosion and causing flows to be intermittent where they were once perennial.

Impacts

Historically, Cedar Creek suffered a variety of injuries, including cottonwood eradication in Big Canyon (East Cedar Creek), high road densities in sensitive areas, and overgrazing. Constant pressure from community horses and seasonal use by cattle hampers growth of native vegetation in the uplands and along riparian areas. Overgrazing combined with lack of fires has stimulated juniper encroachment throughout the watershed. Salt cedar (*Tamarix* sp.) has overrun the lower reaches of Cedar Creek, and seedlings as well as a few mature trees have established in Cedar Creek above the community.

Ongoing Efforts

Several small demonstration projects have been constructed at R-14 Ranch, Middle Cedar Creek, and Big Canyon. Riparian areas were fenced off from livestock to demonstrate the potential recovery of these systems through revegetation. Because East Cedar Creek and R14 crossing have water year-round, they offer good areas for restoration. The response of vegetation when protected from grazing is impressive, with cottonwoods growing rapidly over the past four years and herbaceous vegetation becoming lush in East Cedar Creek.

Riparian Vegetation

The once magnificent cottonwood gallery forest in Cedar Creek is in jeopardy. Recent floods and subsequent erosion control projects have removed many large trees, and those that remain are decadent. Although many small trees grow in the floodplain, they are grazed, stressing them and forcing them to grow in shrubby forms. Most of these seedlings are not protected from floods are therefore are unlikely to survive. Very few trees appear to be in the middle of the population curve (10-50 years), which is a sign of ecosystem degradation. Arizona Alder (*Alnus oblongifolia*) is another key riparian species that is not maturing in most areas.

Key herbaceous species are still abundant in the area, particularly spikerush (*Eleocharis*) and three-square (*Scirpus pungens* or *americanus*). However, most of these are heavily grazed except inside the exclosures. Watercress (*Rorippa nasturtium-aquaticum*) is abundant at spring areas, providing valuable habitat for the native fish in this system.

Channel Morphology

Analysis of aerial photography shows a dramatic reduction in stream sinuosity, from 1.5 in 1937 (normal for a Rosgen C type) down to 1.1 or less in the sections above and below the Highway 60 Bridge. The channel was channelized once again in 1993 in an attempt to halt bank erosion at the JFK School. This situation calls out for a strong education program with the schoolchildren so that the community will have a better informed voice in the management of their stream. The in-channel gabion baskets are preventing the stream from reestablishing a natural morphology, because pools cannot scour through the wire. The altered channel is aggrading and will continue to rise until the sediment and woody vegetation is eventually wiped out by another catastrophic flood.

Bank erosion is a major problem, particularly from East Cedar Creek down to R14 Crossing. These conditions are primarily due to the loss of stabilizing riparian vegetation.

Water Quality

Water Quality in Cedar Creek is below desired conditions, although it has not been found to violate any of the proposed designated uses. Although temperatures do get into the high 20s (Celsius), the standard for warmwater habitat is 32 degrees. Presumably, Cedar Creek might once have been a marginal cold water habitat where shaded pools were more common. The more important temperature concern may be the daily variation as opposed to the mean.

Fecal Coliform pollution may be a problem in Cedar Creek, particularly since a couple of swimming holes are still used. Limited sampling has not detected a violation of the standards thus far.

On at least one occasion, Cedar Creek would have registered a violation of the proposed narrative standards at the R14 Crossing. At this site, we have observed dense algal growth and foul odor. The road crossing impedes the waters at this point, allowing the nutrients and fecal material to settle and decompose. The fish at this site did not appear to be swimming erratically, however. We will monitor Cedar Creek with the Nutrient Enrichment Survey this year.

Turbidity does reach high levels in Cedar Creek (over 100 NTU), although these conditions appear to be the product of general watershed and riparian degradation rather than site-specific impacts.

One of the most serious water quality problems is the lack of flows in many reaches. The West Fork of Cedar Creek is intermittent. For much of the year, the main stem of Cedar Creek goes underground above R14 crossing and again below it, for the rest of its course down to the confluence with Carrizo Creek. Fish may be able to pass from Carrizo Creek up the main stem to the perennial reaches during runoff periods. However, in general the lack of water prevents the attainment of designated uses such as body contact or warmwater habitat.

Non-Point Source Impacts

The major non-point source impacts are livestock grazing and (presumably) septic systems. Livestock grazing degrades riparian habitat, which in turn leads to increase sedimentation. Both the grazing and the septic systems undoubtedly contribute nutrients to the system, which leads to enriched conditions in slow water areas (such as R14 Crossing). Livestock grazing and bank stabilization projects have prevented reestablishment of native riparian vegetation, thereby increasing stream temperatures and reducing the ability of the system to remove sediment and nutrients from the water column. The Tribe and Indian Health Service have planned to establish sewer services in Cedar Creek.

Riparian Conditions

We imagine the potential condition of the stream based upon verbal descriptions provided by long-time residents, who describe a lush riparian area dominated by willow, alder, and

cottonwood. A few locations also had populations of reed (*Phragmites australis*). Residents report that as recently as twenty years ago the riparian area was very green and appeared to be relatively healthy. Flooding in 1993 and subsequent flood control work dramatically altered the riparian area. We postulate that a cycle of severe flooding and recovery of woody vegetation has controlled Cedar Creek for many decades, and that breaking out of this cycle depends on restoring wetland herbaceous vegetation (i.e. three-square, rushes, and spikerush) and upland grass cover.

The entire length of Cedar Creek that we evaluated is not fully functional, but the most severe problems occur in the reach below the confluence of the East and West branches down to R14 Crossing. This reach has been extensively channelized for flood control purposes, resulting in lack of shade and vegetated banks. Presumably, these areas have very low fish density due to the lack of natural habitat. **We evaluated the main stem as dysfunctional for these reasons.**

We evaluated the East and Middle Forks of Cedar Creek as functional--at risk, due to the fact that vegetation, particularly those species indicative of high soil moisture, is not vigorous and healthy. Furthermore, bank erosion and downcutting are occurring in areas. Woody debris helps to stabilize the banks but it is not abundant. The areas within the restoration projects are improving.

The restoration area at R14 crossing is now densely vegetated compared to the heavily grazed area surrounding it, but the tributary to Cedar Creek is headcutting, resulting in a dewatered floodplain that does not sustain sufficient wetland vegetation. We are studying the rate of the headcutting, and at some point an aggressive physical restoration will probably be needed to restore the channel and to ensure access to cornfields at the site.

Recommendations

Due to their general nature, best management practices are not likely by themselves to cause the necessary improvements in stream health. The following are the recommended actions to improve the health of Cedar Creek:

- Modifying and then following the Range Management Plan for Cedar Creek Livestock Association to allow longer rest of sensitive riparian and wetland areas and to reduce pressures on overgrazed uplands
- Using a combination of prescribed burning and woodland treatments in watershed areas to reduce gullying, promote establishment of grasses, and restore a more effective water cycle
- Establishment of an Adopt-A-Stream Project with the students of the JFK School in Cedar Creek, similar to the one developing at Cibecue
- Close unneeded roads in the upper portion of the watershed as timber sales are conducted
- Conducting active riparian restoration efforts such as fencing and revegetating at sites that community members feel are important

IV. Black Watershed

Overview

The Black Watershed is the second most remote on the Reservation (after Canyon Creek) and contains some of the most pristine areas. The BIA once considered a proposal to manage the watershed as a wilderness area for tribal members to carry out traditional activities. The Government rejected this idea in favor of opening the virgin forests to logging, which led to the extension of the Apache railway and establishment of Maverick logging town. For many years, part of the watershed was managed as a Game Reserve and had abundant deer and elk. Today the area offers some of the best recreation experiences in Arizona, including wildlife hunting and fishing, and presents great opportunities to develop other activities, including rafting, photography, nature hikes, and youth education programs.

A major effort to restore watershed health in the eastern half of the ID Range is currently underway with funding from the US Environmental Protection Agency. This effort is following a plan that will continue to be revised.

Water Quality

We have not intensively sampled water quality in the Black Watershed except in Lofer Cienega, but spot checks have not shown any exceedances of proposed standards. High temperatures and low dissolved oxygen levels would be the most likely concerns in the streams. Several of the lakes have suffered fish kills in the summer, possibly exacerbated by nutrient enrichment. Cattle grazing is common around the lakes and their inlets. ADEQ sampled Reservation Creek below the Reservation boundary and found full support of designated uses on the creek.

Ess Creek shows some signs of low water quality. We have observed no fish (although there are fish downstream in Pacheta Creek) and crayfish are present; these conditions suggest a possibly impoverished aquatic community. For these reasons, Ess Creek is a water body of concern. Of the waterbodies that we examined, they all fully support designated uses.

The major water quality issues in the watershed are the following:

Temperature increases

High temperature is one of the major impacts to trout populations. Channel downcutting contributes to bank destabilization and loss of cover. Losses of streamside cover, bank erosion and sedimentation in turn elevate temperatures.

Sedimentation due to bank erosion

Bank erosion causes sedimentation, which increases temperatures and can cause infilling of gravels.

Eutrophication of lakes

Animal wastes, grazing of inlet areas, and loss of riparian vegetation may exacerbate naturel eutrophication. The Wildlife and Outdoor Recreation Program is draining Drift Fence Lake to improve its condition after weeds became a major problem. pH levels tend to soar during the summer months, resulting in poor fishing conditions. Tonto Lake receives high levels of grazing in the watershed draining into the lake.

Riparian Ecosystem Health

All the water quality problems in the watershed are associated with non-point source impacts (and in the case of the reservoirs, some natural limitations on water quality). In general, they are not impacts to water quality per se, but impacts to the riparian ecosystem. Therefore, the best strategy for improving water quality is to address the watershed and riparian impacts, which are overgrazing (by cattle, feral horses, and elk) and roads (primarily crossings of meadows and streams).

Black River

We have not intensively studied the Black River itself. A cursory investigation along the river between Pacheta Creek and 10 of Diamonds Ranch revealed many signs of disturbed watershed conditions, including bank erosion, channel instability, and overgrazed riparian zones. However, there are many reaches with native sedges along the banks. Good riparian conditions have also been reported further downstream (Jon Cooley, Outdoor Recreation Coordinator, Personal Communication). During runoff events, the Black River does become turbid, a condition that appears to have changed from the past, when the Black was clear in comparison to the White (Tom Ensman, US Fish and Wildlife Service, Personal Communication).

High Country

The high country south of Mt. Baldy is in excellent condition, with healthy populations of sedge and hairgrass in the mountain meadows. Purcell Cienega exhibits good wetland conditions and harbors the Arizona Willow. Hall Cienega is also in very good condition, although it is somewhat drier, perhaps reflecting past downcutting due to overgrazing (the entire area was leased to non-Indian permit holders who grazed sheep and cattle in high numbers in the first half of the century). Cattle management in the high country has been a problem as they have gotten into several troublesome areas: riparian zones, campgrounds, fishing areas, and off-Reservation exclosures. The ID Range Management Plan calls for excluding cattle from the area except possibly for holding stock en route to sale.

Big Bonito Drainage

Riparian assessments in the Big Bonito drainage have been confined to intensive work in Lofer Cienega, Butterfly Cienega, and Butterfly Creek. The reports on Lofer Cienega provide greater detail. The Butterfly sites are included in the summary of watershed conditions of ID Range below, as well as in a wetland assessment report for Butterfly Cienega.

Big Bonito itself is one of the most important streams on the Reservation from a fisheries perspective, as it harbors good populations of trout and native fishes. It may serve as a possible reintroduction site for Loach Minnow due to its remoteness and good condition (Stuart Leon, USFWS, personal communication). We included Big Bonito in water quality sampling in 1995. The riparian area is in good condition, with native sedges stabilizing stream banks above the Y40 crossing for several miles.

Lofer Cienega

Lofer and Boggy Creeks were found to be dysfunctional due to severe downcutting, siltation, and loss of native bank vegetation. They also suffer water quality impairments due to high temperatures caused by the lack of shade. The native fish populations are also greatly diminished within the cienega. The condition of this wetland is detailed in separate reports.

Odart Cienega is one of the more important wetlands in the Black River drainage, due to its size and wetness. Large herds of elk, horses, and cattle place heavy pressure on the cienega during the summer months. The area should receive less use due to intensive horse trapping efforts, increased elk hunting pressure, and less use from cattle under modifications to the Turkey Creek Range Management Plan included in the Lofer Restoration Project.

Tonto

The lower portion of Tonto Creek is in excellent condition with healthy populations of Speckled Dace, Desert-Mountain Sucker, Sonoran Sucker, Rainbow Trout, and Brown Trout. The Y47 road and grazing (by feral horses, elk, and cattle, including many maverick animals) have degraded the upper portion of the stream, resulting in a wide, poorly vegetated channel.

ID Range Watershed

The ID Range constitutes the heart of the Black River watershed, which includes the southwestern portion of the Fort Apache Reservation, the northeast corner of the San Carlos Reservation, and much of the Apache National Forest. The ID Range area has been a priority for assessment and restoration planning. We established several stations to monitor riparian conditions, including:

1. Pacheta Cienega (3 stations)
2. Ess Cienega (2 stations)
3. Deep Cienega
4. Soldier Spring
5. Maverick Cienega
6. Butterfly Creek
7. Hurricane Creek

These stations reveal high levels of utilization, trampling, and compaction, in some cases leading to channel downcutting (Pacheta and Ess). Horses seem to have the greatest impact in

the area around Ess Cienega and east to the boundary, including Soldier Spring. We have observed cattle impacts particularly in Pacheta and Maverick Cienegas.

Field investigations have also revealed damage to Paddy Creek throughout its watershed. As logging and roads are negligible in this watershed, the major impact appears to be grazing. Heavy cattle use is responsible, as small, roving herds drift in from the winter ranges along the Black River; many of them may be from San Carlos.

Impacts to Wetlands and Riparian Areas

There are over fifteen large cienegas located within the ID Range grazing area. Many of the cienegas have changed drastically over the past decades. Cattle, elk, and feral horses congregate on the cienegas for long periods of time. Feral horses in particular tend to return to certain areas, but cattle have often been encouraged to stay in one place through location of salt, pasture fencing, or attraction to water during the hot summer months. Overgrazing and trampling by ungulates have caused the following problems:

- Stream banks collapse
- Stream channels widen and get shallower
- Willows die or fail to reproduce
- Native plants decrease (with impacts on small wildlife such as voles, garter snakes, and amphibians)
- Aggressive mesic plants increase (including iris and Kentucky bluegrass)

The areas are not being allowed to rest from the heavy grazing pressures. The combination of wildlife and livestock graze most areas year-round.

Pacheta Creek at Upper Pacheta Cienega: Functional

Grazing pressures had altered Pacheta Creek in the Upper Cienega. By 1997, the channel had downcut about two feet, drying the meadow and expanding bluegrass cover. The channel changes from an alder-lined B channel above the cienega, to an E below the road crossing, to a G in the downcut section, to a marshy area in the middle of the cienega. Due to the ongoing downcutting, reduced bank stability, and reduced wetland vegetation, we evaluated this reach as functional--at risk. The trend for this reach was declining. The stretch that had downcut to hardpan was dysfunctional, since it no longer reached the floodplain.

Fortunately, a restoration project in Pacheta Cienega appears to have been successful in reversing the degradation at this site. A large exclosure has been established and gravel bars were placed in the channel to restore a natural Rosgen E-type morphology. Now Pacheta looks like one of the best streams on the Reservation.

Ess Creek in Ess Cienega: Functional--At Risk

Both streams in Ess Creek have shown signs of degradation, although the eastern channel has downcut considerably. This change has dewatered the meadow somewhat, causing in a shift toward drier disturbance plants. We tried fencing the cienega in 1996, but elk and horses soon knocked the fence down. Nevertheless, the cienega did have less utilization than in the

previous year. Due to the reduced bank stability and wetland vegetation, we evaluated this stream reach as functional--at risk.

Reservation Creek: Functional

Deep Cienega

Reservation Creek is one of the finer trout streams on the Reservation, perhaps owing to its gravel-rich soil type. It has a hardy composition of sedges that promotes good bank stability. However, the channel does appear overly wide in some reaches. Cattle have grazed the cienega for many years, although usually for only short periods. In 1998, conditions in Deep Cienega appeared good.

Above Reservation Lake

We assessed Reservation Creek above Reservation Lake and found it to be in functional condition, with stable banks covered with native sedges.

Soldier Spring: Dysfunctional

We assessed Soldier Spring in late October 1995 and visited it again in June 1996. Both trips revealed a high level of plant diversity, reflecting a combination of degradation (resulting in invasion of disturbance plants) and its location in a transition between ecological zones (mountain meadow and canyon stream). The channel goes through a series of different types, from steep, entrenched G types to floodplain C types. Overgrazing is severe along this stream. Horses appear to be the dominant grazing animal, although elk may be significant contributors as well.

We had evaluated this reach as Functional--At Risk due to the low plant cover and lack of defined banks. Plant composition appears to change on the Forest Service (downstream) side, with different plants appearing and fewer disturbance plants. Grazing impacts seem less severe downstream. The stream appears somewhat more confined in that reach, which may protect the stream.

By 1998, the reach has become dysfunctional due to severe downcutting that resulted in a deeply entrenched and badly eroding channel. A major project to restore this important stream received funding support from the US Fish and Wildlife Service. The first stage of restoration activities was completed by September, with the construction of a large electric fence.

Pacheta Creek from Maverick Cienega to Falls: Functional--At Risk

Maverick Cienega is a stark demonstration of overgrazing. The combination of feral horses, elk, and cattle is responsible. We observe a sharp contrast in willow health and density upstream and downstream of a pasture fence in the cienega, although a change in soil type contributes to this condition. Overgrazing and trampling has resulted in a wide, shallow channel with poor bank stability. Fish densities were found to be unusually low for a trout stream in a meadow. Dozens of unmanaged cattle appear to spend the summer around this cienega.

Overgrazed conditions extend down to Pacheta Falls, with bank erosion and loss of cover in reaches with naturally broad floodplains. The short boulder-dominated reaches in confined canyons are stable and healthy, with dense growth of sedges that provide a seed source.

Butterfly Creek: Functional--At Risk

The station at Butterfly Creek reveals overgrazed conditions (elk and cattle). For much of the year, the channel is dry, perhaps due to the lack of dense ground cover in the riparian zone and higher up in the watershed. The stream becomes perennial a quarter mile below the R55 road crossing. The road crossing has altered the natural hydrology of the meadow and should be replaced with a design that will avoid concentrating flows, such as a french drain.

Butterfly Creek is difficult to evaluate because it has existed in a degraded condition for over thirty years, so it is hard to discern its potential. Removal of the road and restoration of natural hydrology could improve riparian conditions. Because there are signs of bank instability and low vegetative cover, we evaluated the site as functional--at risk.

Below the road crossing in June of 1998 the stream was in very good condition with dense wetland vegetation across the riffle areas. There were some areas of bank erosion and channel downcutting that could be treated with minor channel work.

Hurricane Creek: Functional--At Risk (Stable)

We assessed two stations in Hurricane Creek below Hurricane Lake in 1995. They revealed generally good conditions, including key riparian species (sedge, Arizona Willow), although we observed signs of bank instability associated with grazing impacts. Cattle have drifted up the creek to the meadows around the lake, posing a nuisance to fishermen as well as impacting the riparian zones. This problem seemed especially acute during the drought of 1996. The new ID Range Management Plan, which will remove cattle from the area, should improve this situation. The Turkey Creek Livestock Association plans to rest the country west of Hurricane Creek in 1997, therefore no cattle should be in the area this year.

The signs of bank instability resulted in an evaluation of Functional--At Risk.

Thompson Creek in Hall Cienega: Functional

A University of Arizona student with assistance from the Watershed Program staff assessed Hall Cienega in 1996. Results are pending from that assessment, but visual observations indicate a stable, healthy riparian system. The channel is a fine example of a very sinuous E channel with stable, undercut banks. These conditions resulted in an evaluation of functional.

The Fish and Wildlife Service renovated the creek and restocked it with native Apache Trout from Firebox Creek in 1996. Hall Cienega showed some signs of cattle use in 1996, but relatively very little. Elk use is undoubtedly the major impact to the cienega.

Paddy Creek: Functional--At Risk (Declining)

Paddy Creek is a moderate watershed with unique values, including many springs on the side slopes and populations of Apache Trout (although they have hybridized with rainbows).

The conditions in the watershed are poor due to overgrazing by cattle, with dysfunctional characteristics such as eroding banks, lack of native aquatic plants, and lack of ground cover to resist erosion. Only a few patches of native riparian herbaceous plants remain in the valley below Paddy Creek Cienega.

Soil Types

The Luna Clay Loam soil types predominates in the cienegas of ID Range. Deep Cienega has a different soil type, the same as that found in Smith Cienega. Both of these areas are extremely productive for both plants and trout. They also harbor populations of the Arizona Willow. An abundance of gravels, which may increase oxygen levels in the soil, may provide the favorable habitat for both the Arizona Willow and Apache Trout.

Bebb Willows also require gravel deposits combined with subsurface water flows to establish and survive.

The Luna Clay Loam soils in many of the cienegas are resistant to downcutting due to the high clay content (Paddy Cienega is a good example). However, portions of these cienegas have higher silt compositions that erode easily, for example, on the east side of Ess Cienega. The gravels in these soils tend to be an essential component for fish and willows, so when they wash out, downcutting and habitat degradation can quickly follow. Nebraska sedge (*Carex nebrascensis*) is the main native riparian plant in the cienegas, but in most areas Kentucky Bluegrass, an exotic competitor, predominates.

Soil Type	Cienegas	Habitats	Dominant Range Plants	Suitability for Wetlands	Soil Profile	Significant Biological Associations
Gordo Loam (33D)	Deep Cienega, Outer portions of Pacheta Cienega, Meadow below Hurricane Lake, Meadows above Reservation Lake	Hilly areas and Mountain Meadows	Arizona Fescue, Tufted hairgrass, and Sedge	well suited Wetland plants and Wetlands	Deep A Horizon with fine granular structure in and many very fine interstitial pores; B horizon has high percentage of pebbles and cobble and many fine interstitial pores	Arizona Willow habitat, High production of Apache Trout
Luna Clay Loam, wet variant (55B)	Ess, Pat, Willow, Pacheta, Paddy, Drift Fence, Butterfly, Maverick, Pair O'Dice, Bee, Y, Tonto, Sheep Cienega, Bonito Rock, Race Horse	Mountain Meadows	Arizona Fescue Spike Muhly Sedge	well suited for Wetlands and Wetland plants	Shallow A horizon with common very fine interstitial pores; Deep B horizon with few fine interstitial and tubular pores	Bebb Willow

Cienega Conditions

Past grazing pressures have altered many of the cienegas within the ID Range area (see to Granfelt Lake Site Reports from the 1960s). Many of the cienegas were wetter than they are today. Vegetation composition has also changed to drier, less desirable species. Plants are being severely grazed, keeping them below their potential levels.

Paddy Cienega is relatively healthy, although sedges are overgrazed, with relatively low densities and no litter. Using a conical exclosure in the meadow for comparison, utilization appears to be over 80%. Downcutting is occurring only in two places in the meadow, one above the stock tank and one at the fence line by the ranch house. The high clay content of the soil resists downcutting despite the overgrazing. However, the lack of ground cover dries out the soils quickly. Paddy Creek Cienega still has dense populations of sedges, but it is losing its natural function of storing water. Furthermore, many of the Bebb Willows appear to be in poor health, probably due to drying of the meadow.

Sheep Cienega is being invaded by iris, particularly on the eastern arm. Iris is a native weed poisonous to livestock that becomes more common on overgrazed, deteriorated ranges. Cattle and horses tend to concentrate within the cienega for most of the summer months.

Tonto Cienega (the meadow above Tonto Lake) is in poor condition due to overgrazing. There are many stunted, grazed willows within the Cienega.

Y Cienega is in fair condition. Native sedges are heavily utilized.

Bee Cienega is in poor condition. Plant density and ground cover are very low. Many areas have bare ground and exposed rocks. Salt blocks placed in the west portion of the cienega have caused bare areas.

Ess Cienega has suffered a shift from native sedges to Kentucky Bluegrass. One of the channels has downcut considerably, drying the meadow. Feral horses concentrate heavily in this area.

At **Pacheta Cienega**, past grazing pressures have altered portions of the Cienega from a Fescue-Muhly grassland type to a Fescue-Bluegrass type. Pacheta Creek had begun to downcut due to overuse. This condition had contributed to drying of the meadow, shifting the plant composition toward bluegrass, and reducing fish habitat. Fortunately, the restoration project at this site appears to be helping to raise the water table and restore the native wetland plants at this site. This successional process will need to be monitored to determine the rate of change.

Maverick Cienega has suffered from overgrazing. Bluegrass is the dominant plant, and overall ground cover is low. Willows are heavily browsed. A large group of cattle, probably feral, continuously graze the southern half of the meadow below a fence line. The soil type has fewer gravels and therefore becomes less suitable for willows below this line.

Butterfly Cienega is in poor condition. Bluegrass covers most of the cienega, and iris is invading the northeast portion of the cienega because of the grazing pressure. During the wet months there are several small standing ponds located in the west half of the cienega. Vegetation within this area consists of stunted sedges and spikerush. Cattle and horses concentrate within the cienega for most of the summer months.

Deep Cienega is one of the better sites within the ID Range, due to its high elevation and productive soils. Wild onion (*Allium* sp.) was extremely abundant in mid-summer but had died off by October. Sedge grew in high density by October 1996. Past grazing pressures have changed a portion of the cienega from a Fescue-Muhly type into a Fescue-Bluegrass type. In the past, many cattle concentrated in the cienega during the summer for a few weeks. Under the new plan, however, cattle should be removed and excluded from this area.

Vegetation Production and Utilization

We constructed three 10m x 10m monitoring exclosures in late June to monitor production and utilization at Butterfly Cienega, Deep Cienega, and Ess Spring Cienega. The following chart summarizes production and utilization at the sites mentioned above. For comparison, production from a riparian exclosure on Wildcat Creek, in the neighboring Apache-Sitgreaves Forest (in the same watershed), after one season of rest was 2830 kg/ha. Buck Springs on the Coconino National Forest produced 4315 kg/ha after four seasons of rest [Medina 1995]. Range guidelines suggest that wet meadows can typically produce 4000 lbs/acre in a wet year, and 2200 lbs/acre in a dry year.

Amounts in kg/ha (10 kg/ha = 9 lbs/acre)	**Production and Utilization on cienegas in ID Range Area**						
	Butterfly		**Deep**		**Ess**		**Wildcat Exclosure (Apache National Forest)**
Date of Measure	30 July	17 October	17 July	17 October	5 Aug	10 Oct	Full Season
Production	580	880	1380	690	244	204	2830
Amount Remaining	310	383	1380	620	174	54	2830
Percent Utilization	46%	57%	N/A	12%	28%	74%	0%

Implementation of Fencing and Other Protective Measures

The ID Range Management Plan called for several changes to the fences that are currently in place on ID rangelands. The most important project is construction of a new boundary fence running from Butterfly Cienega east to the Reservation boundary, passing south of Maverick Lake. Another boundary fence will be constructed to the south to exclude cattle from the rough terrain along the Black River.

Investigations in 1997 and 1998 revealed that feral cattle are a major impact in the watershed. Several small herds graze cienegas away from the main herd at ID Ranch. These animals appear skittish and are probably resident in the cienegas for most of the summer.

Recommendations

Need for Restoration

The cienegas of the Black River watershed are in terrible condition as a result of recent decades of over use. The combination of inadequately managed cattle, horses, and elk are simply too great for these systems. Much of the vegetation on these meadows has shifted to bluegrass, sneezeweed, and iris. A Challenge Cost-Share Restoration Projects has restored Pacheta Cienega. A second project at Ess Cienega has been less successful due to failure to control livestock and damage to fences by elk. The Wetlands Conservation Plan (1998) prioritized areas for restoration. Utilization in wetlands and along streams needs to be greatly reduced. The populations of animals and their impacts on streams need to be monitored to determine whether levels are sustainable while providing for recovery of degraded areas.

Summer use of high country areas needs to be carefully planned and controlled to protect the wetlands. Most of the existing pastures include numerous streams and wetlands. Several smaller holding pastures are located directly on the wetlands. Those situations need to be completely avoided.

Implementation of the ID Range Management Plan is a major step in restoring health to the ecosystems of the ID Range areas. The plan calls for eliminating cattle use in the sensitive areas (at least in the near-term as the systems recover) and greatly reducing feral horse impacts through an aggressive trapping program. Both the Tribe and the State of Arizona have increased hunting pressure on elk. Together, these changes should induce a dramatic recovery of the streams and wetlands of this area.

Monitoring of established sites is a priority for the next few years, to document what changes are occurring.

V. White Watershed

Upper North Fork Watershed

The Watershed Plan, prepared in 1996, includes details about this watershed. Most of the streams are meeting water quality standards and are fully functional. Several streams, including Ord Creek, Smith Creek, and Snake Creek have outstanding reaches that serve as reference conditions. The most prominent exception to good water quality is Becker Creek, with sedimentation problems that affect water quality in the summer. At Horseshoe Cienega, downcutting had resulted in dysfunctional reaches, but an ongoing restoration project has been successful in restoring proper function.

Horseshoe Cienega

Horseshoe Cienega has been the subject of an intensive restoration project, including fencing to exclude livestock, reseeding, transplants, and riffle bar placement. The project has yielded significant results in restoring a more stable channel morphology (E-type) in reaches that were formerly downcut. We plan to evaluate the success of the project in restoring habitat for trout that venture from the lake to spawn.

Gooseberry Watershed

A separate assessment report describes the intensive monitoring around McNary, Haystack Cienega and Neagle Ranch in detail. Until this year, Gooseberry Creek around Haystack Cienega had been dysfunctional and did not support fish populations. The reaches above and below this area had concerns due to limited fish populations and lack of perennial flow.

The winter of 1997-1998 brought heavy snows to the watershed, yielding high levels of water in the system through June. The vegetation responded vigorously to the water and the restoration efforts of the previous year. Many reaches appear to be on track toward fully regaining proper functioning condition. Fisheries biologists from the Pinetop AZFRO office are exploring to potential to reintroduce Apache Trout to this system.

Bog Creek

We have not intensively studied Bog Creek, but it appears to suffer from riparian degradation associated with overgrazing in many reaches.

Trout Creek

Trout Creek may be the most significant source of sediment into the White River and causes turbidity to rise substantially during precipitation events. Preliminary investigations suggest that road construction on highly erodible soils was the major factor. Subsequent monitoring by the Tribal Hydrologist revealed that natural erosion of these soils are also a major factor. Restoration efforts are needed to reduce erosion from both the road and the naturally eroding outcrop.

North Fork

The North Fork of the White River shows signs of watershed degradation, particularly high turbidity levels after rain storms. The main causes of the turbidity may be Becker Creek in the upper reaches and Trout Creek in the lower section. The North Fork does have some reaches in poor channel condition, marked by braiding and dense growth of shrubs. The Hydrology Section of the Tribe has been regularly sampling the North Fork for *E. coli* bacteria, finding levels of concern but few clear violations of the standard for primary contact to date. Because of these levels and the high recreational value of this river, the Tribe has targeted the reach above the confluence with Diamond Creek for increased monitoring and eventual restoration.

East Fork

East Fork appears to be in excellent condition in the roadless area up to Mt. Baldy; we assessed one site in that reach. Conditions appear good down to the gauge above Rock Creek. The creek starts to show serious problems below Firebox Creek; bank erosion, downcutting, and algal growth are common down to the confluence with the North Fork. We will study this watershed in greater detail in the coming year.

Most reaches in the community area are functional at-risk, but some highly disturbed areas are dysfunctional. Most dysfunctional reaches suffer from highly altered channel morphologies, caused by berms, irrigation diversions, rip-rapped banks, and bridges. These reaches have unstable banks, low sinuosity, and poor riparian vegetation dominated by coyote willow, sweetclover (*Meliolotus*), and various other weeds.

East Fork has the potential to support excellent riparian communities. Key wetland plants including a variety of sedges (*Carex* spp) and three-square (*Scirpus pungens* or *americanus*) are present in many areas.

Water Quality

E. coli bacteria levels were sampled in 1998 at several locations along the river. The sampling has yielded only one sample above the standard for Primary Contact.

Data loggers recorded temperatures in East Fork throughout the summer. The data shows that temperature is indeed a major concern in the river, as levels reached nearly 30 degree Celsius.

Restoration Needs

Four areas must be addressed to restore health to the East Fork Watershed:

1. Channel Morphology: highly disturbed reaches should be restored through reestablishment of natural channel morphology using heavy equipment. Restoration should use rock weirs and careful placement of large woody debris for bank cover and protection. Irrigation diversions should be redesigned to reduce dam effects by providing more flow-through of fine sediments during flood events.

2. Riparian Vegetation: native wetland vegetation must be reestablished along stream banks throughout the watershed. In some floodplains areas, the growth of coyote willow and other aggressive shrubs may limit recovery unless they are removed. These woody plants tend to concentrate flows during floods rather than dispersing them evenly across the floodplain, which may result in increased downcutting and bank erosion. Transplanting and reseeding may help to speed reestablishment following channel restoration efforts. Grazing impacts do not appear to be a major problem, although community horses may reduce the stock of native wetland plants needed to provide seed sources for disturbed areas.
3. Sedimentation from roads: badly eroding roads such as those found in Firebox Canyon need to be closed or redesigned to reduce sedimentation.
4. Septic systems: failed septic systems are a suspected problem in reaches where houses are located in the floodplain. Fecal coliform levels should continue to be monitored to try to identify possible sources.

VI. Upper Salt Watershed

Cibecue Watershed

The Cibecue Watershed has been the subject of a watershed analysis currently being finalized. Greater detail on watershed conditions can be found in that report.

Main Stem of Cibecue Creek

The main stem of Cibecue Creek has vigorous woody riparian vegetation along the reach from White Springs to Salt Creek, but impaired herbaceous vegetation throughout. The creek becomes very unstable below the confluence with Salt Creek, with severe bank erosion and little riparian vegetation. The abundant woody plants may hinder recovery, since they shade out the native wetland plants. Heavy grazing by horses may favor the woody plants.

The Tribe submitted a proposal to the Arizona Water Protection Fund to restore 2 miles of the creek north of town through fencing, channel restoration, and revegetation.

Cibecue Canyon and Spring Creek

The Watershed Program has conducted and evaluated two restoration projects in Cibecue: Cibecue Canyon and Spring Creek. Both are systems with intermittent flows that reflect degraded watershed conditions (severe erosion associated with past overgrazing). Both are lacking many of the functional processes needed for a healthy system, but it is difficult to gauge the potential of these systems due to the high number of factors contributing to the degradation, the long-time period of the degradation, and the lack of base flows.

White Springs

The Cibecue crew conducted restoration work at White Springs, including fencing, revegetation, and erosion control. The preliminary results were positive, with significantly reduced erosion and growth of vegetation. Another year is needed to determine how well native wetland vegetation will recover at the site.

Water Quality

E. coli bacteria counts were measured at several locations along Cibecue Creek in early 1998. The results were well below the primary contact standard.

Salt River

The Salt River (Medicine) area has improved due to the removal in the winter of 1997-1998 of a large number of maverick cattle that had been left to graze the area for about eight years. The removal combined with a wet spring to produce a dramatic growth of wildflowers and grasses, although many of these are exotics. The riparian areas showed improvements, with good growth of various sedge species. Continued implementation of the

range management plans for this area should promote recovery of both uplands and riparian areas. The removal program should target Canyon Creek and the Gleason Flat area in the 1998-1999 season.

Canyon Creek

A combination of rest from grazing and prescribed burning could yield improvements in the Canyon Creek watershed around Oak Creek, and this area may be a good choice for a demonstration project.

Canyon Creek does possess key wetland species, such as water sedge, but heavy grazing pressure limits the recovery of the riparian areas.

VII. Water Quality

Overview

Water quality in Reservation waters is generally good because most of the watersheds are undeveloped for habitation. Most waterbodies are meeting their proposed designated uses, except where watershed conditions are so degraded that water flows are not sufficient to support aquatic life. Degraded riparian conditions are the major water quality problem because they result in higher temperatures and lower dissolved oxygen levels that impact trout and other aquatic organisms.

Community Concerns

People can still swim and fish in most of the usual places; however, many residents are concerned about the safety and availability of these activities in their communities. One of the problems with determining the extent of these problems is that the group that is most likely to swim and fish close to their homes is the youth. Many adults report that the areas where they used to swim and fish are no longer good for those activities; however, it is not clear to what extent the changes have occurred due to water quality problems or to changes in stream morphology. For example, people cannot use many swimming and fishing holes because channel movements and bank erosion eliminated the pools. These types of impacts compound the water quality problems, by reducing the ability of the stream to filter pollutants and to provide shade, and also by concentrating use (now all the kids go to the few remaining holes).

Suspected Problems

Two water quality problems that appeared to be serious concerns in several watersheds are fecal coliform and nutrient enrichment. Streams such as East Fork and Cibecue show extremely high levels of algal growth that are reportedly more prominent than ten years ago. Cedar Creek and North Fork also show signs of enrichment. These conditions may be the result of septic leaks, animal use, or riparian degradation. Algal growth is also common in the relatively pristine Canyon Creek, suggesting that animal use and degradation of riparian systems may combine to cause the problem. Horses, cattle and elk deposit wastes into the streams that may cause fecal coliform contamination and nutrient loading. Degraded riparian areas do not filter the water with floodplain vegetation and have areas of slow water and high temperatures that promote algae growth.

East Fork, North Fork, and Cibecue are being investigated through fecal coliform testing and nutrient sampling. The results thus far have not found major problems in most areas, although the North Fork has regularly yielded high enough levels of *E. coli* to merit continued studies.

Water Quality Conditions

Water Quality Conditions in Reservation water bodies fit into the following categories:

1. Full Support: meeting standards and criteria
2. Concern: requiring further investigation of suspected problems
3. Partial Support: violating proposed standards, although supports designated uses
4. No Support: failing to support proposed designated uses

Explanations for the conditions listed in the Watershed Assessment Table are detailed in the previous chapters (for Cedar and Black Watersheds), the Upper North Fork Watershed Plan (for the Upper North Fork), the Lofer Cienega and Gooseberry Watershed Assessment Reports, and the Water Quality Sampling Report. Furthermore, detailed information on the East Fork and Cibecue Watersheds comes from Site Assessment Reports. We designated these waters as concerns based on recent assessment work that has found high levels of algae in the community areas.

Designated Uses

The Tribe's proposed standards include a variety of uses of water. The uses most vulnerable to impairment are fish habitat and full body contact. We have assessed conditions for fish, but have not studied body contact. These uses will be the target of more sampling in the future. We are also engaging in sampling of toxics in fishes to ensure the safety of fish consumption by people and wildlife.

Causes of Non-Support of Designated Uses

The major factors impairing waterbodies are:

1. Degradation of Habitat (reduction in flows, bank erosion, unstable morphology)
2. Temperature
3. Dissolved Oxygen

Sources of Non-support of Uses

Rangeland management, both past and present, is the primary source of non-support, including grazing by livestock, feral cattle and horses, and wildlife. Much of the damage occurred in the past, but continuing impacts limit recovery.

Channel manipulations for the flood control projects in Cedar Creek prevent the stream from attaining a functional condition.

Earlier chapters on watersheds and the following chapter on nonpoint source pollution include details on sources of non-support.

Toxicants--Limited Assessment

The threat of toxicants is relatively low in most of the Reservation waterbodies and would be associated primarily with discharges regulated under the NPDES, for example, sewage lagoons and water treatment plants where household or industrial chemicals might be improperly disposed. The new permits for Reservation discharges include requirements for

sampling toxicants. Inventories of toxic substances used on the Reservation have been compiled by the Tribe's Environmental Planning Office, which has also conducted training on proper care and storage of toxic materials.

Levels of mercury and copper have been detected by the State of Arizona in the Black River and in the White River in the 1980s. However, limited sampling in 1995 found no detectable levels of mercury. We do not know to what extent these metals occur naturally, but as there are few alternative sources, we suspect that the sources are natural. Toxicological studies are being conducted jointly by the Tribe and the US Fish and Wildlife Service.

Lakes--Water Quality Not Assessed

Our program has not assessed water quality in lakes. The Tribal Wildlife and Outdoor Recreation Program and Pinetop Fishery Resources Office do sample fishing lakes during the summer months, and both have reported concerns about high pH levels and high temperatures. However, their results have not determined whether the causes are natural or induced. Grazing impacts around the lakes or upstream in the watershed could be increasing nutrient levels coming into the lakes. Coordination with the fisheries programs continue with the goal of sharing information and targeting priorities for assessment.

Because we are lacking data on the lakes, this report does not address those waterbodies.

Wetlands addressed in Wetlands Assessment Report

The Wetlands Planner has prepared a comprehensive assessment of wetlands in a separate Wetlands General Assessment Report.

Ground Water Quality--will be addressed in separate report

Ground water quality is being assessed under a separate Source Water Protection grant, currently administered by the Tribal Hydrologist. The results of the Groundwater Assessment will be available in late 1998. Only limited data on ground water quality is available at this time, most of it concerning conductivity measurements used to analyze source aquifers. Due to the lack of data, we did not include ground water quality in this report.

VIII. Nonpoint Source Pollution

Overview

The majority of water pollution on the White Mountain Apache Reservation does not arise at single discharge points. There are less than a dozen such discharges, mostly for sewage treatment lagoons and package plants, and they are regulated under the National Pollutant Discharge System (NPDES). The dominant sources of nonpoint source pollution are open range grazing, hydrologic or habitat modifications of streams, leaking septic systems, and runoff from forest roads, highways, and other impervious surfaces. Fecal coliform and nutrients are potentially serious concerns, particularly in community areas and in recreational lakes. Degraded watershed and riparian conditions and wildlife grazing contribute to nonpoint source pollution. The resulting pollution is primarily sediment and turbidity, as well as increased temperatures, lower levels of dissolved oxygen, and higher pH levels. An important point is that diminished water quality is typically not the limiting factor in most of the aquatic ecosystems; rather, it reflects degraded riparian and watershed conditions. The exceptions to this point are Becker Creek, where silt from Sunrise Resort has infilled the stream, and the twenty-six fishing lakes, where nutrification is a major concern. Hazards to swimming and other bodily contact may also result from water quality problems, although we have not determined the extent of such problems.

Sources of Impairment and/or Threats to Water Quality

Alteration of natural stream function is the primary threat to water quality, because dysfunctional streams have elevated levels of sediment, turbidity, pH, nutrients and temperature, and lower levels of dissolved oxygen. These conditions adversely affect aquatic life in the streams. These problems continue into lakes where they may pose problems for valuable recreational fisheries. Earlier chapters include summaries of stream dysfunction.

Grazing

1. Open range land

Overgrazing is a threat to water quality where streams are destabilized through trampling and overgrazing of streambank vegetation, resulting in sedimentation, loss of shade, and alteration of natural sediment and water transport capacity. We have observed these impacts throughout the Reservation. Many horses graze in community areas along the streams, particularly Cibecue Creek, Carrizo Creek, and Cedar Creek. Cattle have impacted many riparian areas, where they have been allowed to congregate for long periods due to insufficient management systems. Wildlife populations, primarily elk, contribute to the overgrazing of range lands, particularly at elevations about 6,000 feet. Feral animals, chiefly horses but also cattle in the southern parts of the Reservation, are one of the major impacts to watershed health.

2. Animal holding or management area

Heavy use of pastures along perennial streams and wetlands is a major source of stream destabilization, since animals concentrate in the riparian areas. Pasturing is common during the summer months when soils may be saturated, animals are less likely to move themselves away from water sources, and plants are trying to flower.

We have observed these impacts in the North Fork Watershed (Horseshoe Cienega, Bebb Willow Stand, Cooley Spring Pasture) and Black Watershed (Maverick Cienega, Paddy Creek Cienega, Deep Cienega, and Pacheta Cienega).

Road Impacts

1. Sedimentation

Forest roads and highways can discharge sediment into streams. These problems are most pronounced in the upper, wetter parts of the watershed where roads where constructed several years ago.

2. Modification of Stream Hydrology and Habitat

Roads and parking lots may also modify hydrological and habitat features. We found these problems where culverts are improperly installed and in the parking lots at Sunrise where materials are deposited in the stream channel.

Surface Runoff

Runoff from the parking lot areas at Sunrise Resort appears to be the major source of siltation in Becker Creek. Runoff is also coming off developed areas in Whiteriver, including the new Executive Building.

Dredging

Maintenance of Lake Ono at Sunrise has involved dredging materials from the impoundment. This activity has resulted in siltation in Becker Creek.

Septic Systems

Failed septic systems have been cited as a probable source of contamination in community areas. The Indian Health Service reports that most failures are associated with old systems (greater than 20 years old) which were inadequately designed and maintained. Although many reaches are suspected of having failures, specific locations have not been identified and continued monitoring is needed to identify problems.

Natural sources

Natural sources, including degraded watershed conditions (gully erosion, for example) resulting from past abuses and wildlife impacts, constitute the remaining major source of pollution. Erosion of natural landforms, as seen in Trout Creek, remains a major contributor of sediment and high turbidity.

Impaired Waterbodies that Require Nonpoint Source Controls

It is the desire of the Tribe to maintain or restore functional ecosystems on its lands, with a subsidiary goal of maintaining or improving high water quality, particularly in high elevation watersheds. The following waterbodies require nonpoint source controls to meet proposed tribal water quality standards:

- Becker Creek
- Lofer Cienega
- Gooseberry Creek
- Cedar Creek

Even with nonpoint source controls, areas such as Lofer Cienega, Cedar Creek and Gooseberry Creek may continue not to meet proposed standards. These areas require long-term restoration measures before they regain their functional processes.

IX. Nonpoint source pollution threatens waters across the Reservation, even though most currently meet tribal water quality standards. We provide more detailed summaries of stream dysfunctions in earlier chapters of this report, but most of these do not constitute violations of the proposed water quality standards.

X. Information on nonpoint source impairments, causes, and sources are included in the

Watershed Assessment Report Summary Tables (Appendix 4).

Summary of Nonpoint Source Impairments

Waterbody	Impairment / Threat	Cause	Degree of Impact	Source	Assessment Level
Becker Creek	Impairment	Siltation	H	Road maintenance Surface runoff Dam construction Streambank modification / destabilization	Evaluated
Lofer Cienega	Impairment	Bank Erosion, Downcutting	H	Range land Natural Conditions	Monitored
Gooseberry Creek	Impairment	Bank erosion, lack of shade, lack of water flows	H	Range land Natural Conditions	Monitored
Cedar Creek	Impairment	Lack of shade, lack of water flows, possible fecal contamination	H	Hydrologic / Habitat Modification Range land Natural Conditions (gullying) Roads	Monitored

Current Programs

The Tribe has a number of programs in place to deal with issues related to nonpoint source pollution.

Stream Restoration

The Tribe manages a riparian area restoration program with funding from the Job Training Partnership Act and US Fish and Wildlife Service Challenge Cost-Share Program. This program has begun to restore key stream habitats on the Reservation, including Upper Horseshoe Cienega, Lofer Cienega, and Gooseberry Watershed.

Water Quality

The Tribe monitors water quality under the Watershed Planning Program, funded under the EPA 106 project.

Wetlands

The Tribe's Wetlands Planner is developing a comprehensive Wetlands Conservation Plan that will address many of the same impacts identified in this report.

Sensitive Species

The Tribe's Game and Fish Department has developed a management plan for the Arizona Willow that calls for protection of habitat. This Plan has guided fencing projects designed to maintain healthy riparian zones.

Livestock Associations

All the tribal livestock associations have range management plans that call for protection of sensitive riparian areas. The Turkey Creek, Cedar Creek, Cibecue, Carrizo, and Forestdale Livestock Associations and the ID Herd are cooperating on plans to restore degraded stream areas.

Range Conservationist

The Tribal Range Conservationist has been working in concert with the Watershed Program and Livestock Associations to implement restoration projects and otherwise improve range management on the Reservation.

Process for Identification of Best Management Practices

For most problems, prescribing best management practices will promote, but not necessarily restore, watershed health, which is the primary source of water quality problems. As we investigate nutrient and fecal coliform pollution in community areas, we may learn of more problems that BMPs can address. However, for areas such as Lofer Cienega and Gooseberry Watershed, our approach of trying to reduce impacts to these damaged riparian areas through livestock and wildlife management seems to hold the best chance of restoring proper function.

Throughout the development of plans for the watersheds of the Reservation, numerous individuals representing multiple disciplines and management entities have shared their thoughts on how to protect the valuable ecosystems. Previously, we developed a plan for the Upper North Fork Watershed. In the past year, representatives from the Tribal Agricultural Enterprise, the Game and Fish Department, Range Conservationist, and the Watershed Program developed a plan for ID Range.

XI. We have begun discussions with numerous entities for the Cibecue Watershed Project. The core of this process is the Cibecue School, which is conducting interviews with local residents to identify their concerns for the watershed. Technical experts involved with this process include the USFS Rocky Mountain Experiment Station, and the USFWS Pinetop Fisheries Resources Office.

XII. Conclusion

Overall Conditions and Concerns

The watersheds of the White Mountain Apache Tribe are not as healthy as they once were, but they are relatively unpolluted. There are concerns about possible septic leaks and animal wastes in community streams; we have been studying these issues in greater detail in Cibecue and East Fork. Yet, the most overwhelming problem is that decades of cumulative impacts have degraded the watersheds, many of which are continuing. The most widespread of these impacts is overgrazing by both domestic and wild animals. Restoration projects designed to exclude grazing animals are yielding promising results in small areas. When considering all the impacts to the watershed, however, the impacts are too broad and too hard to see for them to solve with swift actions. The best strategy for addressing these impacts is to assist local communities with assessing watershed health so that they can decide for themselves how to manage their waters. With better understanding, community members may assume more responsibility for taking care of their surrounding lands and waters. The Cibecue Watershed Analysis Project has been a pilot effort in this process. We will extend a successful model to other communities on the Reservation.

Despite the extensive discussion of impacts in this report, the most powerful explanation for the unhealthy condition of the waters is the one most often provided by tribal members: the loss of respect for the land. The relationship between the people and their land has been breaking down for the past hundred years. In Cibecue, the people working on the Watershed Project have begun to document the changes in the land and in attitudes. One of the residents explained, "we knew what the Government wanted to do was wrong, but we let them do it. They went against Nature, and now we just have to let the river take care of itself," (paraphrased from an interview by Delbin Endfield with a fellow Cibecue community member).

Recommendations to Improve Water Quality

Restoration Strategy

The land and waters do have the capacity to heal themselves, as demonstrated in our restoration projects. As a strategy for improving watershed health, we cannot do much better than allowing nature to take care of herself. However, the ongoing impacts to streams, such as overgrazing, channel manipulations, and septic leaks must be reduced or halted before the natural recovery processes can work. There are opportunities to speed the natural processes through active revegetation and even reshaping the channels to follow natural patterns. The success of these measures may depend on how well the community understands and promotes the natural restoration processes. Education will prove to be the most important step towards restoration. Assessment is a necessary component of education, because we all need to understand what these systems are doing before we can hope to restore them. For these reasons, we recommend continuing the work of the Watershed Program by developing partnerships with local schools. At the very least, we can provide information to help people to improve their watersheds, if not today, then tomorrow.

Steps to Meet Goals of the Clean Water Act

The Clean Water Act's goal of healthy waters for fishing and swimming fit well with the concerns of tribal members. Many people have concerns about the overall health of waters, including the availability of spring waters for drinking and water-loving plants. The best means of promoting the health of waters consistent with community concerns is to empower the communities to monitor the waterbodies in their watersheds. Local schools working in partnership with the Tribal Watershed Program represent a powerful combination of energy and expertise for managing the water resources of the Reservation. The Adopt-A-Watershed Program should expand to other schools and to encompass a certified volunteer-based monitoring component. Students should have access to simple, inexpensive testing equipment as well as using their own observations to identify potential problem areas. Then further investigations can evaluate the extent of the problems. School programs also present a good opportunity to develop long-term data records of water quality, provided that we establish standardized procedures and sampling sites.

The Watershed Program will implement this proposal through the following steps:

1. Develop adopt-a-watershed curriculum for use in local schools (currently in progress with Cibecue Community School)
2. Enlist additional local schools as partners in the adopt-a-watershed program
3. Expand monitoring plan and Quality Assurance Plan to encompass student volunteer monitoring
4. Work with summer youth programs, Tribal Fisheries Program, and Pinetop Fisheries Resources Office to conduct water quality assessments in recreational waters

After a local school has become a partner, the Watershed Program will jointly implement the following steps:

5. Develop long-term watershed- and community-specific monitoring plans and integrate into school curriculum
6. Acquire additional monitoring equipment (thermometers, pH Meters, and test kits for various parameters)
7. Conduct watershed analyses to identify water quality limitations, nonpoint source impacts, and degraded riparian habitats
8. Develop plans to improve watershed health
9. Implement watershed restoration projects

The involvement of schools will provide a critical vehicle for community outreach, but it will not be the only means. We will continue to publish articles in the *Apache Scout*, and utilize the local radio station, to announce the results of our ongoing efforts and to help inform the public about ways to reduce nonpoint source pollution.

Role of Environmental Protection Agency in Helping the Tribe

The EPA has prioritized addressing issues on a watershed scale emphasizing restoration efforts through the Unified Watershed Assessment and Restoration Strategy. The goal of these national efforts is similar to what the Tribe is conducting on its lands. The Environmental Protection Agency has provided critical support in developing the Tribe's Watershed Program. Backing of the Tribe's efforts, through additional funding and technical assistance, will allow the Tribe to further develop a strong, community-based program. The two main areas that need to expand and come together are watershed analysis and environmental education. This approach follows the principle of sustainability, by reinforcing the connections between environmental protection, economic development, and community well-being. We hope that the EPA will increase support for the development of community-based watershed efforts.

Executive Summary

Introduction

The watersheds of the White Mountain Apache Reservation are in good condition, with relatively clean water that supports fishing and swimming. However, the past century has witnessed considerable degradation of the environment, so the lands and waters are no longer as healthy and diverse as they used to be. Losses of native vegetation along streams, bank erosion, and channel downcutting and widening are symptoms of watershed and riparian degradation that affects the health of tribal ecosystems and the quality of life on the Reservation. Many people complain about the loss of fishing, swimming, and natural beauty of their surroundings. Along with the widespread deterioration of the rivers, we suspect that leaking septic systems, recreation and grazing along riparian areas may be causing some nutrient enrichment and fecal coliform pollution. The Tribe's efforts to restore its lands and waters has yielded impressive results at several sites, returning formerly dysfunctional or declining streams back to health. This progress can be sustained by initiating new projects under the Tribal Land Restoration Program. By working with community groups to plan restoration projects and obtaining outside funding for projects, the Tribe can continue to restore its ecosystems.

Purpose

The purpose of this report is to provide information regarding the state of the waters of the Reservation, including biological, chemical, and physical factors. The report addresses the condition of the water itself, the streams through which it flows, and the sources of impacts. The period of record for this report is July 1994 through June 1998. This report provides a summary of water quality concerns and identifies riparian ecosystems that are not in good health.

Geographic Coverage

This report covers the entire Reservation, but intensive monitoring has been limited to particular watersheds and project areas. The following reports provide greater detail for particular areas:

- **Gooseberry Watershed Reports (1996 and 1997)**
- **Lofer Cienega Reports (1996 and 1997)**
- **Cibecue Watershed Analysis (Draft Completed 1998)**
- **Upper North Fork Watershed Plan (1995)**
- **Wetlands Conservation Plan (1998)**

Water Quality

The water in streams appears to be good quality and supports swimming and fishing. The most widespread problems are high temperatures, low dissolved oxygen, and high turbidity, all of which result from riparian degradation. Water quality problems are most prominent in community areas such as East Fork, North Fork, Cibecue, and Cedar Creek, where growth of algae in streams reportedly is a worsening problem. Ongoing sampling has found fecal coliform levels to exceed standards for primary contact on a few occasions, but a definite pattern or specific location has not been identified. Furthermore, nutrients levels have been sampled in selected waterbodies with minor concerns over phosphorous that is most likely associated with upland erosion rather than point sources.

Riparian Health

The majority of the riparian areas evaluated in this report are not fully functional, based on hydrology, vegetation, and morphology. Most are functional, but past degradation and ongoing impacts render them at risk to further deterioration. Some areas have improved since 1997 due to ongoing tribal restoration efforts, including Pacheta Cienega, Horseshoe Cienega, and parts of Lofer Cienega and Gooseberry Creek. Still the majority of Lofer Cienega, two reaches along Gooseberry Creek, and Cedar Creek within the community are dysfunctional, meaning that they do not maintain critical functions such as providing fish habitat, reducing flooding, preventing erosion, or providing safe water. These reaches have an undesirable channel morphology, marked by past downcutting, severe bank erosion, and lack of habitat for recolonization by wetland vegetation.

Nonpoint Source Assessment

Nonpoint source sources cause most of the pollution to Reservation waters. Conditions are best in the protected high elevation area around Dził łigai sián (Mt. Baldy), and they are worst at lower elevations on the west side in the Cibecue and Carrizo watersheds. The White and Black watersheds are in relatively good condition, although they contain many wetlands in degraded condition.

The chief nonpoint source impacts are grazing (by domestic livestock, feral animals, and wildlife) and dysfunctional channels (that are kept from recovering due to structural modifications for bank protection, irrigation diversions, and roads). We suspect leaking septic systems (mostly older ones) to be a source of pollution in community areas, based on initial stream surveys and reports from community members, the Tribal Utility Authority, and Indian Health Service. Recreation may be contributing to fecal coliform pollution along the North Fork and perhaps other intensively-used areas.

Broad Recommendations

1. Enlist local schools to conduct monitoring, planning and restoration efforts for their watersheds. Since tribal members both suffer the consequences and enjoy the benefits from activities that impact watershed health, the community needs to have information about the condition of their environment so they can make good decisions. Local children need to learn more about their waters so they can monitor changes and help to take care of their environment.
2. Monitor, maintain, and establish new restoration projects to demonstrate the potential for riparian recovery.
3. Work with the Land Restoration Board and local community groups to identify new demonstration projects.

Site Photos

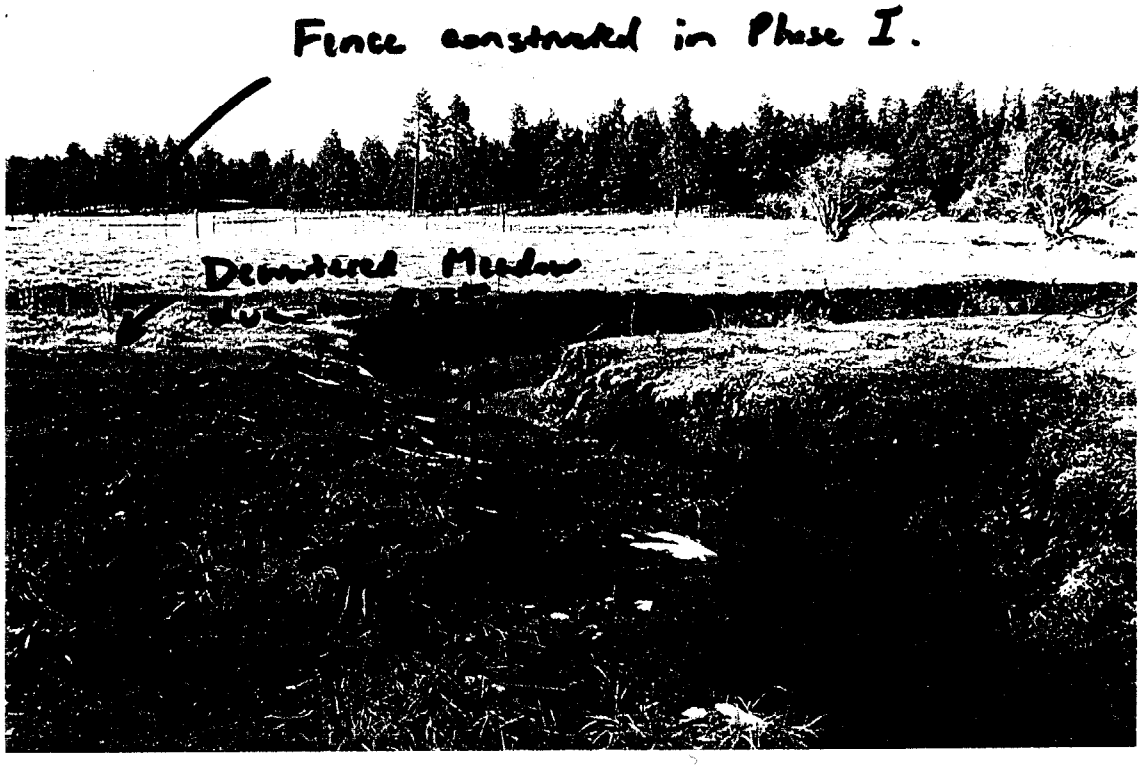
Gooseberry Watershed Restoration Phase II SITE PHOTOS

(TOP: Gooseberry Creek at the monitoring station by the **Bebb Willow Stand** (looking northwest). Wetland vegetation is recovering in the channel, however, the channel downcutting has dried the meadow and keeps the banks steep and unstable. Riffle bars would be constructed starting at this reach and extending upstream for approximately 1 mile.

The riffle bar technique was tried successfully in 1997 to promote recovery of the channel between these two reaches.

New fences constructed through the 1st Phase of the Gooseberry Project are allowing the recovery of wetland vegetation once it can be established.

BOTTOM: Gooseberry Creek at the monitoring station in **Haystack Cienega**. The wide, square-bottomed, (Rosgen "F" type) channel does not provide good places for aquatic plants to establish. Riffles would be placed in this mile-long reach to provide such micro-habitats and to spread water over the banks during floods.



Before and After Photos Demonstrating the Riffle Bar Restoration Method to be used on the Lofer and Gooseberry Phase II Projects

BEFORE: Pacheta Cienega, **June 1996**. The creek had downcut 1-2 feet due to overgrazing by ungulates. The meadow was fenced in 1996 to reduce grazing pressure. However, rest alone could not cure the disease. Note how low the water surface is in relation to the undercut banks. The downcutting has dried up the meadow so that the sedges are outcompeted by exotic Kentucky Bluegrass.

AFTER: Pacheta Cienega, **July 1998**. Riffle bars were constructed through this reach in 1997. The bars were being raised at the time of the photo (causing the temporary increase in turbidity). Note the height of the water in relation to the stream banks: now the sedges are able to get the water they need. Sedge transplants have successfully established in the constructed riffles. Mark Nemeth, Tribal Fisheries Biologist, and Malchus Baker of the Rocky Mountain Station are examining the dramatic changes.

Lofer Cienega Restoration Phase II SITE PHOTOS

Boggy Creek below Station #2 looking north-north west (monitoring cage #3 at right) during spring runoff. Riffles placed in 1997 are dispersing flows across the meadow (riffles are under water where the "white caps" are visible).

Boggy Creek below Station #3 looking upstream (to the east) showing two riffle bars placed in 1997. Spring runoff has partially eroded the riffle in the foreground due to the undersized material and steep grade. The Phase II Project will use larger materials and more transplants to ensure that the riffles will withstand high flows. Extending the work for three years will allow work to dynamically adjust to changes in the channel.

Lofer Cienega Restoration Phase II SITE PHOTOS

Lofer Station #1 on Lofer Creek immediately below elk exclosure, facing upstream (southeast)

Note revegetation in channel bottom and dense growth inside exclosure; the headcut appears to be stable, but downstream downcutting still threatens this reach.

Riffle bars would be constructed below this reach.

Side gully on Boggy Creek in the upper cienega (looking southeast); although vegetation is present and recovering, the downcut channel is threaten. to erode further. Riffle bars would be placed in this reach to prevent further downcutting and allow the channel to stabilize. This photo shows how the meadow is dewatered due to the downcutting, since water runs off violently rather than soaking into the ground.

Lofer Cienega Restoration Phase II SITE PHOTOS

Lofer Creek below Station #1 after high spring runoff (looking upstream to the east). The orange color on the right side of the bed shows where the channel has downcut into fresh hardpan. The entrenched channel cannot recover without active restoration. For this reach, structures will need to include more large cobbles and even small boulders to build a stable platform for the gravel riffles on top (see schematic for riffle bars). The structures are need to encourage revegetation in the channel bottom and to raise the water table in the meadow.